

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/529,291
Applicant : Jung Gu Lee
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Examiner : Kuang Y. Lin

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DECLARATION UNDER 37 C.F.R. § 1.132 OF NACK JOON KIM

Commissioner for Patents
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I, Nack Joon Kim, declare that:

1. I am currently Professor and Director in the Center for Advanced Aerospace Materials, POSTECH.
2. I have a Ph.D. degree in Materials Science.
3. I am named as an inventor or co-inventor on 6 United States Patents.
4. I am a co-inventor in the present application.
5. I have been conducting research in material sciences and metallurgy since 1981. I have co-authored over 250 peer-reviewed research papers related to material sciences and metallurgy, have given over 30 invited lectures around the world on the topic, and have advised or co-advised 50 Ph.D. dissertations or Masters theses on the topic. I have been actively involved in the research of amorphous materials since 2001 and continue to be active in the area, including serving currently on several conference and workshop program committees related to the topic.

6. I co-authored the paper "Continuous fabrication of bulk amorphous alloy sheets by twin-roll strip casting" submitted with this Declaration.
7. I am familiar with United States Patent Application serial no. 10/529,291 by inventors Jung Gu Lee et al., including the claims presently pending before the United States Patent and Trademark Office (PTO). In this Declaration, I will refer to the application as "the Lee application" and to the invention described and claimed therein as "the Lee invention."
8. I have reviewed the Office Action dated January 11, 2007 and understand that all claims have been rejected as failing to comply with the enablement requirement of 35 U.S.C. § 112. Specifically, the U.S. Patent Examiner contends that the Lee application does not enable the use of the Lee invention with respect to alloys other than copper-based alloys.
9. I understand that all claims have been rejected by the PTO on the additional ground of obviousness under 35 U.S.C. § 103 over any of the Uedaira, JP 60/248,854, and JP 55/73,448 references in further view of the Peker reference.
10. The purpose of this Declaration is to present evidence to the PTO regarding: (a) why the Lee application does enable a person of ordinary skill in the art to make and use the Lee invention and (b) why the Lee invention is not obvious in view of the references cited by the PTO.
11. The Lee application is a U.S. national stage entry of PCT application PCT/KR03/001966 filed September 23, 2003. The PCT application claims priority to Republic of Korea patent applications 10-2002-0058764 and 10-2003-0058337 filed September 27, 2002 and August 22, 2003, respectively. Thus, my analysis is from the perspective of a person of ordinary skill reading the Lee application or the cited references in August 2003.
12. The Lee invention relates to a method for producing an amorphous alloy sheet with structural continuity and relatively large dimensions, rather than a thin film (of 100 µm or less in thickness, for example) dimension. For example, an amorphous alloy sheet in accordance with the Lee invention may have a thickness of about 0.5 to 20 mm.
13. The Lee application teaches a twin-roll strip cast method where an alloy melt is fed into a gap between the rolls and rolls rotate at a rate from 1 to 10 centimeters per second. The Lee application also teaches that each of the rolls has a heat exchange means and that the melt is

cooled at a rate higher than the critical cooling rate for transformation of the melt into an amorphous solid phase when the melt passes through the gap. The Lee application teaches that the gap between the rolls is in the range of 0.5 mm to 20 mm. The Lee application teaches exemplary alloy compositions including Cu-Ti-Zr-Ni-Sn-Si, Cu-Ti-Zr-Ni, Cu-Ti-Zr-Ni-Si, Cu-Zr-Ti, Cu-Hf-Ti, Zr-Nb-Al-Cu-Ni, Zr-Ti-Cu-Ni-Be, and Zr-Al-Ni-Cu-Pd.

14. A person having ordinary skill in the art would recognize that the Lee invention, as described in the Lee application, has applicability to a wide range of glass forming alloys and would be able to make and use the invention with, for example, copper-, zirconium-, iron- and other base alloys. And thus, the Lee application does enable use of the Lee invention with respect to alloys other than copper-base alloys.
15. Moreover, published work by the inventor and others demonstrates that bulk amorphous alloy sheets can be made from alloys other than copper-based alloys employing the conditions of the Lee invention, that is, a rotation speed of 1-10 cm/sec and a roll gap of 0.5-20 mm. "Solidification Behavior of Fe-base Amorphous Alloys during Twin-Roll Strip Casting" by Oh et al. (copy attached at Exhibit 1) describes an iron-base alloy (see p. 434). "Continuous fabrication of bulk amorphous alloy sheets by twin-roll strip casting" by Lee et al. (copy attached at Exhibit 2) describes zirconium-base alloys Vit-1 and LM2 (see p. 988). Both articles describe production of amorphous alloy sheets using methods within the scope of the present claims.
16. The Uedaira reference (U.S. Pat. No. 4,212,344) discloses a method of manufacture of alloy films with thicknesses on the order of tens of microns. Uedaira teaches the introduction of a molten mixture between oppositely rotating rolls where the rolls have rotational speeds of 1,450 or 2,850 rpm.
17. JP 60/248,854 ('854) discloses a copper 200 mm diameter cooling roll, rotating at 3,000 rpm to produce a 30 micron thick amorphous strip of 20 mm in width.
18. JP 55/73,448 ('448) discloses a melt spouting method for producing a ribbon of unstated dimension.

19. The Peker reference (U.S. Pat. Application Publication No. 2002/0142182) discloses sharp-edged cutting tools (e.g., knives) formed from bulk amorphous alloy materials. Peker discloses that such tools can be formed using molding operations or casting operation. It discloses a single diecasting process by incorporating U.S. Pat. No. 5,711,363 (which does not disclose a twin-roll casting method). Peker discloses that it is desirable to use amorphous alloys that can be cooled at cooling rates of as low as 500K/sec or less.
20. None of the references disclose a twin-roll casting method where the gap between the rolls is in the range of 0.5 mm to 20 mm. None of the references disclose a twin-roll casting method where the rotation rate of the rolls is 1 to 10 cm per second.
21. A person of ordinary skill in the art, having read these references, singly or together, would not be motivated to attempt casting a bulk amorphous alloy sheet by slowing the rotational rate of the rolls by three orders of magnitude and increasing the gap by three orders of magnitude. At the time of the Lee invention, it was commonly known in the art that the manufacture of amorphous ribbons requires a very rapid cooling rate and in a twin-roll casting system could only be accomplished by a very rapid rotation of the rolls.
22. A person of ordinary skill in the art would have expected that reduction of the rotation rate would result in crystalline solids rather than amorphous solids.
23. The Lee application teaches and claims that, in addition to using a rotation rate several orders of magnitude from the rates used in conventional amorphous thin film manufacture, there exist minimum and maximum rotation speeds of rolls for the efficient production of amorphous alloy sheets.
24. Moreover, the conventional thinking in the field at the time of the Lee invention was that only thin-film, small dimension amorphous alloy films or ribbons could be formed using twin-roll casting.
25. This conventional thinking of metallurgists is reflected in the published literature within the field at that time. An article attached to this Declaration which I consider to be representative of the conventional thinking as described in the published literature is:

A. Inoue, "Stabilization of Metallic Supercooled Liquid and Bulk Amorphous Alloys,"
Acta Materialia 48 (2000), p. 279, (copy attached at Exhibit 3)

in which production methods of bulk amorphous alloys are described, but the claimed twin-roll casting method is not mentioned. This article discloses an amorphous alloy ribbon of 20 μm thickness.

26. A 2007 article attached to this Declaration similarly reflects this conventional thinking at the time of the invention (and up to August 2005, as implied by the date of the manuscript):
A. Urata et al., "Continuous casting of thick Fe-base glassy plates by twin-roller melt-spinning," *Materials Science and Engineering A* 449-451 (2007), p. 269 (copy attached at Exhibit 4).
Its introduction recites these prior production limitations in which amorphous alloy ribbons only 30 μm in thickness were produced.
27. Also, it is notable that A. Inoue, an author common to the 2007 article (Exhibit 4) cited above and the 2000 article (Exhibit 3), did not mention twin-roll casting of bulk amorphous alloys in the 2000 article, but suddenly used the twin-roll casting after he learned of the Lee invention.
28. The concept of the Lee invention is valuable because strong amorphous alloy sheets may now be produced in a mass scale.
29. The fact that this twin-roll casting method has great value and did not occur to anyone involved in amorphous metallurgy is strong evidence of the non-obviousness of this feature.
30. Finally, the Urata 2007 article, which discloses production of a 0.5 mm thick Fe-base amorphous alloy sheet using a process similar to the present claims, further demonstrates that the Lee application does enable a person of ordinary skill in the art to practice the Lee invention.

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The undersigned declares further that all statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing therefrom.

June 10, 2007
Date

Nack Joon Kim
Nack Joon Kim